No. 617,529. Patented Jan. 10, 1899.

A. HOWARD.

MOTIVE ENGINE.

(Application filed June 13, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

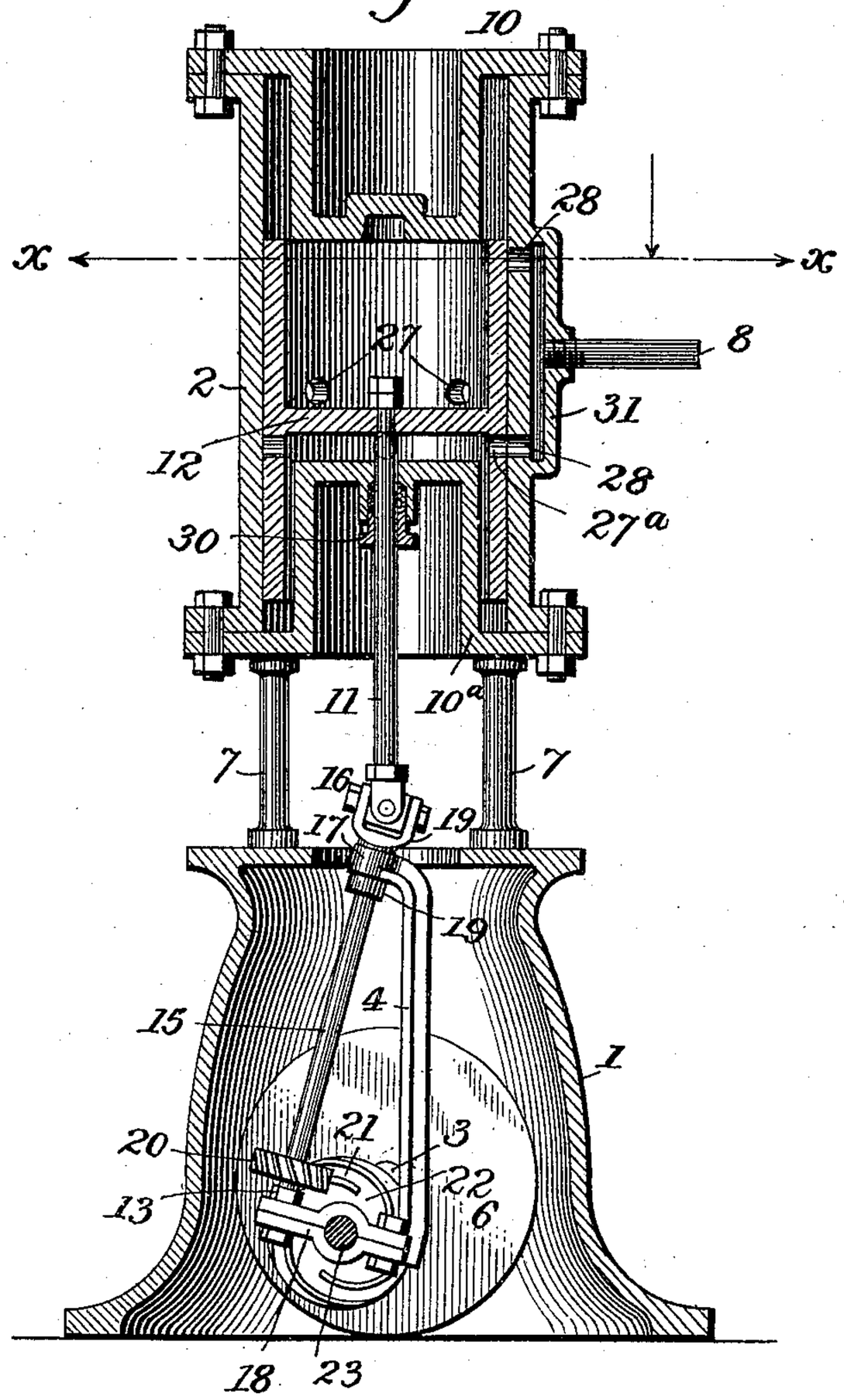


Fig. 2.

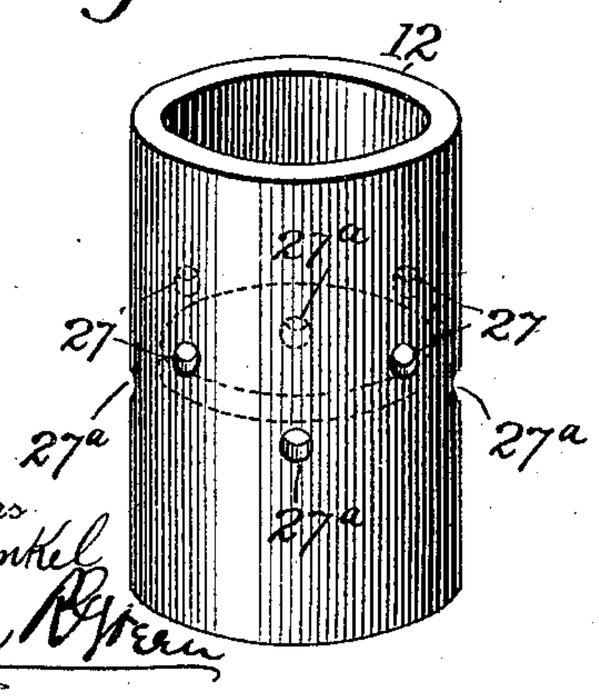
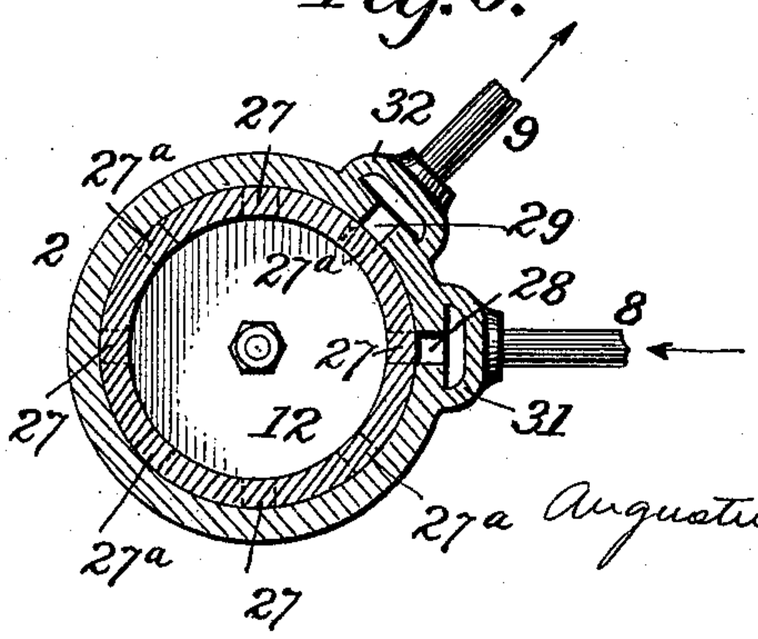


Fig. 3.



Witnesses
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Fig. 4

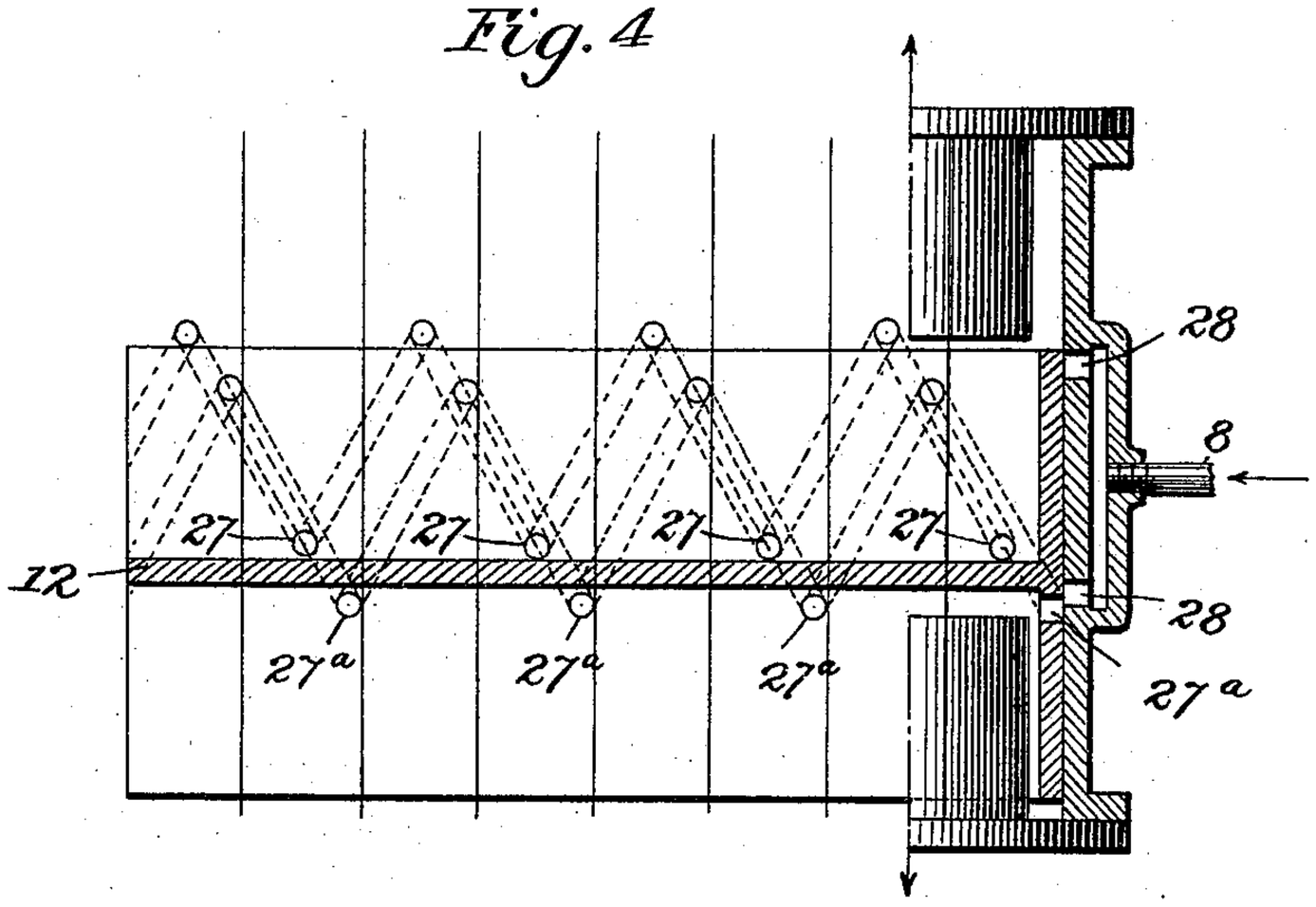
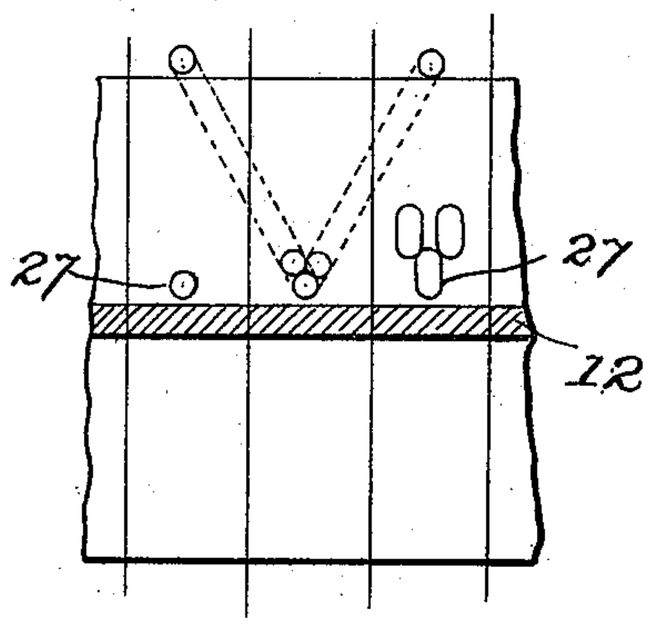


Fig. 5.



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UNITED STATES PATENT OFFICE.

AUGUSTUS HOWARD, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO WILLARD REED GREEN, OF DENVER, COLORADO.

MOTIVE ENGINE.

SPECIFICATION forming part of Letters Patent No. 617,529, dated January 10, 1899.

Application filed June 13, 1898. Serial No. 683,313. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTUS HOWARD, a subject of the Queen of Great Britain, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Motive Engines Driven by Steam or Like Elastic Fluid; and I do hereby declare the following to be a full, clear, and exact description of the said invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to reciprocating engines impelled by steam or other elastic fluid and to a novel mode of applying and distributing such motive fluid by means of certain constructive features embodied in such apparatus.

My improvements consist in employing a cylinder with recessed heads, having inlet and exhaust ports in the walls of said cylinder, in conjunction with a piston of the sleeve type having ports in the sleeved walls thereof, said piston being given a continuous rotary motion simultaneously with its reciprocating motion by means hereinafter described, whereby the ports in the sleeves of said piston are brought into communication with the fixed inlet and exhaust ports in the cylinder-walls in regular and positive succession or sequence, thus opening and closing communication with the source of the motive fluid at the proper times to insure an efficient action of the machine and an economical distribution of the impelling fluid. By this means the use of valves is avoided, the ports in the cylinder and in the piston-sleeves coacting to serve the function of valves; also, by the turning movement given to the piston while making its reciprocating movement the friction of the piston-sleeves upon the walls of the cylinder is reduced, the action and result being similar to that of twisting a cork while inserting it into the neck of a bottle, thus enabling it to be inserted easier and farther than if inserted upon straight lines.

In the drawings forming a part of this specification, Figure 1 is an elevation, partly in section, showing the crank-shaft and the connected means for giving rotary motion to the piston-rod and also the cylinder and the sleeved piston with necessary connections. Fig. 2 is a detail perspective view showing the piston with the ports which perform the function of valves in this device when coöperating with the inlet and exhaust ports of the cylinder. Fig. 3 is a cross-section on line *x x*, Fig. 1, showing in section the chests covering the inlet and the exhaust. Fig. 4 is a diagrammatic view illustrating the movement of the piston-ports displayed on a plane surface, showing the travel and successive contacts of the piston-ports with the cylinder-ports during one complete revolution. Fig. 5 is a detail similar view of some forms of said ports.

Like numerals of reference indicate like parts.

1 is the main frame.

2 is the cylinder, and 3 the crank-shaft, on which is borne a fly-wheel in usual form (not shown) external to the main frame. Said main frame may be inclosed in box form, if desired, so as to contain lubricating material, as in my patented engine hereinafter referred to, on which nothing is herein claimed. The cylinder is supported in any suitable manner on said frame—*e. g.*, on struts 7 (shown in Fig. 1)—and is supplied with an inlet-pipe 8 and an exhaust-pipe 9, which pipes can be connected in the usual manner, so that their function can be transposed and the action of the engine reversed. In the drawings these pipes are shown as attached to chests 31 and 32 on the side of the cylinder leading to the ports; but it is obvious that these connections may be made in any convenient manner.

10 and 10ª are the recessed cylinder-heads.

12 is the sleeved piston, having in its upper sleeve-walls the ports 27 and in its lower sleeve-walls the ports 27ª.

30 is the gland or stuffing-box, through which the piston-rod 11 reciprocates.

The device shown for producing revolution of the piston-rod and piston simultaneously with its reciprocating movement is that set forth in my Patent No. 602,161, dated April 12, 1898. Said piston-rod is coupled to the crank-pin 23 by means of a connecting-rod 15, which is connected to the piston-rod by a universal joint 16, and extends through a

yoke or bearing 17, rigidly connected by an arm 4 with a planetary bearing 18 for the crank-pin 23. Said connecting-rod is also revolubly stepped into said bearing 18 at 13. Above and below the bearing 17 are provided strong collars 19, which receive the thrust of the piston through said piston-rod and connecting-rod. At the lower end of said connecting-rod is secured a pinion 20, having skew-cut teeth which engage with scroll-formed teeth 21, carried on a disk 22, rigidly attached to a crank-disk 6 in a position concentric with the crank-pin 23, but eccentric to the crank-shaft 3, so as to be carried around the latter by the action of the piston-rod and connecting-rod. This portion of the mechanism is identical with that set forth in my said Patent No. 602,161, before referred to.

The operation is as follows: Supposing the piston to be set in motion by the expansive action of the fluid entering the cylinder through the pipe 8 and one of the ports 27 in the piston-wall, the crank-pin 23 and a scroll-disk 22 are set into rotary motion, revolving around the crank-shaft 3. At the same time the pinion 20 is carried around with its bearing 18 and is simultaneously revolved by reason of its intermeshing with the scroll-teeth of scroll-disk 22. This causes connecting-rod 15 to slowly revolve, carrying with it the piston-rod 11 and piston 12. This rotation of the piston, in conjunction with its longitudinal travel, brings the ports 27 27^a in its walls into successive conjunction with inlet-port 28 and exhaust-port 29 in the cylinder-walls, said ports being so located with respect to each other as to be in conjunction at the proper times to allow the desired inlet and exhaust of the working fluid. In the present drawings this scroll-gear by which the piston 12 is revolved is shown so arranged as to produce one revolution of said piston to four revolutions of the crank-shaft 3, and consequently four ports 27 are required in the upper piston-sleeve and four ports 27^a are required in the lower piston sleeve or wall. These ports, as above stated, successively communicate with the ports 28 and 29 in the cylinder-wall, first acting as inlet-ports with the ports 28 and then as exhaust-ports with the ports 29, or the reverse if the engine is to be driven in the opposite direction, the piston in this case being given one-eighth of a revolution on the downstroke and one-eighth of a revolution on the upstroke. This is continued throughout the whole operation. Consequently the ports in the piston-sleeves are located in their distribution around the circumference of the piston alternately in the upper and lower sleeves, so that the ports in either sleeve are upon longitudinal lines passing between the ports upon the other sleeve. In this way the alternate application of the working fluid upon the two sides of the piston is provided for and coacts with the movements of the piston, a port in one sleeve of the piston acting as an inlet, while the cooperating port in the other sleeve is acting as an exhaust-port, and thereby the reciprocating movement of the piston is produced. The revolutions of the piston, as above stated, are governed by the gear on the crank-pin coöperating with the pinion on the connecting-rod. Now to commence the operation of taking in the working fluid, as indicated in Fig. 4, one of the ports 27^a in the piston has an opening to the inlet 28, and as the upstroke continues by the rotating motion of the piston the opening of the cylinder-port becomes more open to the piston-port for the inlet of the working fluid and closes at any required point of the stroke. The point of the stroke can be regulated by the turning of the piston so that the port in the piston will not come fully in contact with the port in the cylinder, but will be partly closed in the travel of the piston. The inlet-port in the piston on one stroke becomes the exhaust-port on the succeeding stroke, so that as the rotation of the piston is equal on all parts of the stroke the ports are placed to alternately communicate with the inlet and outlet ports on the eighth of a revolution.

It is obvious that any other distribution of the ports in the cylinder-walls and in the sleeves of the piston may be adopted as desired, suitable to the circumstances of use.

It will be understood that the point of cut-off, release, lap, and lead can be attained by the disposition and form of the ports, which can be of any form or relative size or location desired, as indicated in Fig. 5; also, that the rate of revolution of the piston relatively to that of the crank-shaft may be any desired ratio, according to the relative gear of scroll-disk 22 and pinion 20.

In case of small engines the diagonal thrust of the connecting-rod 15 may be sustained by the gland 30; but with larger engines a cross-head and the usual ways are employed as guides for the piston-rod.

It will also be understood that the relation between the ports in the walls of the piston and those in the cylinder may be determined or altered by changing the relative position at which the piston 12 is set or fixed upon the piston-rod 11. In other words, by moving the piston on the piston-rod to the right or left, as desired, the character of the engagement of the ports will be altered, and thereby the admission of the operating fluid will be cut off at an earlier or later portion of the stroke, as desired.

I claim and desire to secure by Letters Patent—

1. In a motive engine, a cylinder provided with recessed cylinder-heads, a revoluble sleeved piston in said cylinder, inlet and exhaust ports in the cylindrical walls of said cylinder, ports in the cylindrical walls of said sleeved piston, and means between the piston and the engine-crank for continuously ro-

tating said piston in one direction while it is making both its reciprocating strokes, substantially as specified.

2. In a motive engine, a cylinder having in its cylindrical walls inlet and exhaust ports, a revoluble sleeved piston in said cylinder having ports in said sleeves, a piston-rod connected therewith, and means connected to the crank for positively turning said rod and piston, continuously while making their reciprocating movements.

3. In a motive engine, a cylinder having in its cylindrical walls inlet and exhaust ports, a revoluble sleeved piston in said cylinder having ports in the walls of said sleeves, a piston-rod connected to said piston, a connecting-rod connected by a universal joint to said piston-rod, and means for positively and continuously turning said rods and piston while making their reciprocating movements, substantially as specified.

4. In a motive engine, a cylinder having inlet and exhaust ports in its cylindrical walls, a revoluble sleeved piston in said cylinder having ports in the walls of said sleeves, a piston-rod, a connecting-rod connected by universal joint with said piston-rod, a pinion fixed on the lower end of said connecting-rod, a scroll-toothed gear-wheel fixed on the engine crank-disk concentric with the crank-pin and meshing with said pinion, a shaft, a crank-disk on said shaft and a crank-pin, operatively connected and coacting, whereby a positive continuous rotary motion in the same direction is transmitted to the piston by the revolution imparted to the engine-shaft by the reciprocating movements of said piston and the ports in said piston are successively presented to the inlet and exhaust ports of the cylinder in due order of alternation, substantially as specified.

5. In a motive engine, a cylinder having recessed cylinder-heads and inlet and exhaust ports in its cylindrical walls, a sleeved piston therein having ports in said sleeves, a piston-rod connected to said piston with means for adjusting the piston on the rod and means operatively connected therewith and with the shaft of said engine by which said piston is rotated continuously in the same direction and the ports in said cylinder and in said sleeves are brought successively into operative communication, whereby the working medium is admitted to and exhausted from said cylinder and piston and imparts reciprocating motion to said piston.

6. In a motive engine, a cylinder having ports of suitable form, size and location in its cylindrical walls, a revoluble sleeved piston in said cylinder having corresponding ports in said sleeves, a piston-rod connected with said piston, with means for adjusting the piston on said rod and means operatively connected with the engine-shaft and with said piston-rod for positively turning said piston-rod and attached piston continuously in the same direction, whereby the lap, lead, and exhaust of said ports may be fixed or determined by the relative speeds of the rotation and the reciprocating movement of said piston.

7. In a motive engine, a cylinder having ports in its cylindrical walls, a revoluble sleeved piston in said cylinder having ports in said sleeves, a piston-rod connected to said piston and a joint upon the end of said piston-rod, to alter and determine the relative operative engagement of said ports by turning said piston-rod and piston relatively to the ports in said cylinder, and means for positively turning said piston-rod and piston.

In testimony whereof I affix my signature in presence of two witnesses.

AUGUSTUS HOWARD.

Witnesses:

WALTER B. PAYNE,

ALEXANDER S. STEUART.